electrically equivalent to the standard antenna and does not reduce the battery current drain.

Step (1) Perform the radiated emissions test in § 2.1511 of this part.
Step (2) Perform the modulation characteristic tests in § 2.1513 of this part.
Step (3) Perform the spectral tests in § 2.1515 of this part.
Step (4) With the EPIRB off, place unit in an environmental chamber at a temperature of −20 °C for at least 2 hours.
Step (5) With the EPIRB in the chamber, repeat the carrier frequency test in § 2.1515(d) of this part. (Leave the EPIRB turned on.)
Step (6) Near the end of 48 hours of total on-time for the EPIRB, repeat the carrier frequency test in § 2.1515(d) of this part.
Step (7) At the end of 48 hours of total on-time, remove EPIRB from the chamber and immediately repeat the PERP test for the fundamental emissions in § 2.1511(c) of this part. The unit should be maintained at −20 °C to the extent possible for this test.

(f) *Float free and activation test.* This test is required only for Class A EPIRBs.

Step (1) The EPIRB is to be installed in the automatic release mechanism and the assembly is to be mounted on a fixture simulating a deck or bulkhead as per manufacturer' installation instructions.
Step (2) Submerge the fixture in water in its normal mounted orientation. The EPIRB must float free before reaching a depth of 4 meters and should automatically activate. Activation is to be verified by observing the RF power indicator on the unit or monitoring the transmission with a receiver.

If the EPIRB is equipped with an automatically deployable antenna, the antenna must properly deploy during each immersion. Record observations.

(g) *Stability and buoyancy test.* This test is to be performed on EPIRBs which are required or intended to float. This test is to be conducted in fresh water.

Step (1) With the antenna deployed in its normal operating position, submerge the EPIRB in a horizontal position just below the surface of the water.
Step (2) Release the EPIRB and observe the amount of time required for it to come to an upright position. It must reach its upright position within one second from each position.

The EPIRB must have a reserve buoyancy of at least 5% of its gross weight. It must also float upright in calm water with the base of the antenna a minimum of 5 cm above the water. Record the time required for the test unit to right itself.

(h) *Temperature/frequency test.* The frequency stability shall be measured over an ambient temperature from −20° to +55 °C at intervals of not more than 10 °C. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperture level shall be allowed prior to frequency measurement.

Step (1) Place the EPIRB in the environmental test chamber.
Step (2) Adjust the temperature in the chamber to +20 °C and allow sufficient time for the oscillator to stabilize at that temperature.
Step (3) Measure the carrier frequency in accordance with the procedure in § 2.1515(d) of this part. Record the carrier frequency in Hertz. The carrier frequency at +20 °C is the reference for determining the frequency tolerance.
Step (4) Increase the temperature in the chamber to +55 °C and allow sufficient time for the oscillator to stabilize at that temperature. Measure the carrier frequency using the procedure in § 2.1515(d) of this part.
Step (5) Reduce the temperature in the chamber in 10 °C maximum increments until −20 °C is reached. At each new temperature, allow sufficient time for the oscillator to stabilize at that temperature. Measure the temperature and frequency in each case and plot the frequency vs temperature from −20° to +55 °C.

(i) *Leakage and immersion test.*

Step (1) Completely submerge the EPIRB in water for 48 hours. The EPIRB is to be turned off during this test.
Step (2) Remove the EPIRB from the water and wipe dry.
Step (3) Verify operation by briefly turning the EPIRB on and observing the RF power indicator on the unit or monitoring the transmission with a receiver.
Step (4) Open the EPIRB for examination. There is to be no water inside the unit. Record observations.

§ 2.1511 Measurements of radiated emissions.

The Commission's Rules require that the peak efficetive radiated power (PERP) of a Class A, B or S EPIRB not be less than 75 mW under certain specified conditions. The PERP of an EPIRB transmitter is determined by comparing its level to a reference PERP generated by a standard quarter-wave monopole antenna located on a one wavelength minimum diameter metal ground plane. The Rules also require that all spurious and harmonic emissions be attenuated by a specified amount with respect to the reference PERP. In addition, there is a limit on the PERP of radiated emissions with the switch in the test mode. These measurements are to be made in accordance with the following procedure.

(a) *General set-up instructions.*

Measurements of radiated electromagnetic emissions (EME) are to be performed on the 30 meter open field test site described in § 2.1503(a) of this part and on one of the pair of frequencies listed in § 2.1507 of this part. A receiver, tuned dipole antennas and a calibrated signal generator as described in § 2.1505 of this part are required. The EPIRB should be powered by its own internal battery with its standard antenna attached and deployed.

(b) *Set-up for radiated EME tests.*

Step (1) Place a 121.5 MHz quarter-wave vertical antenna element at the center of the ground plane and connect the output of the calibrated signal generator to the antenna.

Step (2) Mount the tuned dipole antenna on the antenna mast, tune the elements to 121.5 MHz and connect the antenna to the receiver.

Step (3) After an appropriate warm up, turn the receiver to the frequency of the test unit, set the detector to peak mode and the bandwidth to 100 kHz.

(NOTE: It is sometimes helpful to monitor the receiver audio output with a speaker. The EPIRB signal may be identified by its distinctive modulation.)

(c) *Radiated EME tests.*

Fundamental emissions-peak effective radiated power

Step (1) Turn on the signal generator and adjust the output to 75 mW at 121.5 MHz.

Step (2) Vary the antenna height from one to four meters in both vertical and horizontal polarization. Record the highest receiver reading in dBm as the reference level.

Step (3) Disconnect the signal generator and replace the quarter-wave vertical element on the ground plane with the EPIRB under test. The EPIRB is to be positioned directly on the surface of and in the center of the metal ground plane.

Step (4) Activate the EPIRB.

Step (5) Vary the receive antenna height from one to four meters in both vertical and horizontal polarization. Record the highest receiver reading in dBm and the instrument settings, antenna height and direction for maximum radiation, antenna polarization and conversion factors, if any, associated with that reading.

Step (6) Repeat Step 5 with the EPIRB switch in the test position. Return the switch to the normal operation position.

Step (7) Rotate the EPIRB 30 degrees and repeat Steps 5 and 6. Repeat this step for all successive 30 degrees segments of a full, 360 degree rotation of the EPIRB.

Step (8) Repeat § 2.1511(b) and Steps 1 through 7 for 243 MHz.

Step (9) Compute the peak effective radiated power for the maximum level of each measured emission using the following formula:

$$\mathrm{PERP} = 75 \times \log_{10}{}^{-1}\left[\frac{\mathrm{dBm}_{\mathrm{meas-dBmref}}}{10}\right]$$

where:

$\mathrm{dBm}_{\mathrm{meas}}$ is the measured receiver reading in dBm, and

$\mathrm{dBm}_{\mathrm{ref}}$ is the reference receiver reading found in step 2 of § 2.1511(c).

Step (10) Record the PERP in mW. The FCC limit for minimum power in the normal operation mode (i.e., with the EPIRB switch in the normal operating position) is 75 mW. The FCC limit for maximum power in the test mode is 0.0001 mW.

Spurious emissions

Step (11) Reset the signal generator to operate at 121.5 MHz.

Step (12) For each spurious and harmonic emission to be measured, retune the receive antenna to the appropriate frequency and repeat Steps 5 and 7.

Step (13) Determine the FCC limit on power for spurious emissions on the frequency of each measured emission as follows:

The rules require that spurious emissions be attenuated at least 30 decibels below the transmit power level. Therefore, the maximum received power limit for a spurious emission can be calculated from the formula:

$\mathrm{dBm}_{\mathrm{spur}} = \mathrm{dBm}_{\mathrm{meas}} + \mathrm{AF}_{121.5} - \mathrm{AF}_{\mathrm{spur\ freq}} - 30$

where:

$\mathrm{dBm}_{\mathrm{meas}}$=measured receiver reading (Section 2.1511(c), step 5).

$\mathrm{AF}_{121.5}$=tuned dipole antenna factor at 121.5 MHz.

$\mathrm{AF}_{\mathrm{spur\ freq}}$=tuned dipole antenna factor at spurious freq.

Step (14) Record in dB below the fundamental emissions the level of all spurious and harmonic emissions within 10 dB of the FCC limits.

§ 2.1513 Measurements of modulation characteristics.

(a) *Set-up.* Test of modulation characteristics are to be performed in an RF shielded room.

Step (1) Place the EPIRB directly on a metal ground plane, such as the shielded room floor.

Step (2) Place a suitable receiving antenna at a convenient distance from the EPIRB and connect it to the input of the spectrum analyzer or receiver to observe the radiated signal from the EPIRB.

Step (3) Set the spectrum analyzer or receiver controls as follows:

I.F. bandwidth: 300 kHz minimum
Video filter: OFF or as wide as possible
Amplitude scale: Linear
Frequency: 121.5 MHz
Scan width: 0 Hz

Step (4) Connect the detected output of the spectrum analyzer or receiver to the input of the storage oscilloscope.

Step (5) Set the oscilloscope controls as necessary to allow the demodulated waveform to be viewed. The input signal is to be DC coupled.

(b) *Measurement of Audio Frequencies.*

Step (1) Activate the EPIRB.

Step (2) Trigger the oscilloscope and store at least one complete cycle of the audio waveform.

Step (3) Measure the period (T) of the waveform. The period is the time difference between the half voltage points at the beginning and end of one complete cycle of the waveform. See Figure 2.

Step (4) Calculate the frequency (F), where:

$F=1/T$.

Step (5) Repeat Steps 2 through 4 until the highest and lowest audio frequencies are found.

(NOTE: The lowest and highest frequencies may occur several cycles before or after the transition from low to high frequency.)

Step (6) Determine the audio frequency range (F_{range}), where:

$F_{range}=F_{high}-F_{low}$

Step (7) Record instrument settings and the lowest and highest audio frequencies. Record the audio frequency range in Hertz.

Step (8) Repeat Steps 1–7, above, for 243 MHz.

(c) *Modulation factor.*

Step (1) Activate the EPIRB.

Step (2) Trigger the oscilloscope and store at least one complete cycle of the audio waveform. The input signal is to be DC coupled or erroneous results will be obtained.

Step (3) Measure the maximum voltage (V_{max}), and the minimum voltage (V_{min}) for the cycle. The modulation factor (M) is calculated from the following formula:

$$M=\frac{V_{max}-V_{min}}{V_{max}+V_{min}}$$

See Figure 2.

Step (4) Repeat Steps 2 and 3 until the lowest modulation factor is found.

Step (5) Record instrument settings and the lowest modulation factor, expressed as a ratio between 0 and 1.

Step (6) Repeat the above measurements for 243 MHz.

(d) *Modulation duty cycle.*

Step (1) Activate the EPIRB.

Step (2) Trigger the oscilloscope and store at least one complete cycle of the audio waveform.

Step (3) Measure the period (T) of the waveform. The period is the time difference between the half voltage points at the beginning and end of one cycle of the waveform. See Figure 2.

Step (4) Measure the pulse width (t_p) of the waveform. The pulse width is the time difference between the half voltage points on the rising and falling portions of the waveform. See Figure 2.

Step (5) Calculate the duty cycle (D) as follows:

$$D=\frac{t_p}{T}$$

Step (6) Repeat Steps 2 through 5 a sufficient number of times to determine the highest and lowest duty cycles.

Step (7) Record instrument settings and the highest and lowest duty cycles in percent.

Step (8) Repeat Steps 1–7 for 243 MHz.

(e) *Sweep repetition rate.*

Step (1) Connect a speaker to the detected output of the spectrum analyzer or receiver so the audio frequencies are audible. Alternatively, an FM radio tuned to 108 MHz placed in the vicinity of the EPIRB may be used.

Step (2) Activate the EPIRB.

Step (3) Time the number of audio sweeps (N) for a one minute interval.

Step (4) Calculate the audio sweep rate (R) using $R=N/60$.

Step (5) Record instrument settings and the sweep repetition rate in Hertz.

§ 2.1515 Spectral measurements.

(a) *Set-up.* Spectral measurements are to be performed in a shielded room.

Step (1) Place the EPIRB directly on a metal ground plane, such as the shielded room floor. The EPIRB should be powered by